

Appendix A- FY 2006 AFRP Program Status by Watershed

FY 2005 Watershed Program Status

Upper mainstem Sacramento River and upper Sacramento River tributaries

This area extends from the Sacramento River mainstem and all tributaries between Keswick Dam in the north and Stony Creek in the south. There are currently two federal AFRP Habitat Restoration Coordinators (HRC) and one state HRC dedicated to the implementation of restoration actions in this area, which includes technical assistance to local watershed groups and support of their efforts to develop watershed assessment and management documents as well as restoration projects.

In 2005, staff from the AFRP and from the CBDP continued to participate in and fund the Battle Creek Restoration Project. This restoration project will address adult fish passage, flow, and juvenile entrainment limiting factors.

Restoration efforts in the upper mainstem Sacramento River and Sacramento River tributaries geographic area focus on the major AFRP objectives listed in Section III, Program Objectives. AFRP funded and managed projects to address data gaps in fish management (e.g., Sex Reversal of Chinook Salmon) and supported watershed restoration activities with many local watershed work groups. The AFRP HRCs continue to serve as technical advisors for the Battle Creek Conservancy, Cow Creek Conservancy, Bear Creek Watershed Group, Shasta West Watershed Group, Cottonwood Creek Watershed Group, and the Deer Creek Watershed Conservancy. The HRCs also support local watershed groups associated with Lower Clear, Mill, Reeds, and Red Bank creeks, as well as the Sacramento River Conservation Area Forum and the efforts of the CBDA Watershed Program.

Upper Mainstem Sacramento River

Although mainstem Sacramento River and upper Sacramento River tributaries (excludes Clear Creek), AFRP restoration efforts have addressed about 0 to 60% of the AFRP Restoration Plan actions and evaluations (Table 3^b), a considerable number of restoration projects remain to be implemented to attain the natural production doubling goal.

Various CBDP grants have been obtained to acquire land and easements, implement restoration, implement mapping and inventory efforts, implement monitoring and research on a wide variety of natural resource parameters, and support education and planning efforts.

Twenty five AFRP-funded projects have been implemented in the watershed, involving fish inventories/monitoring; riparian restoration, acquisition, and/or easements; genetics maintenance and hatchery-related studies; instream flow studies; project-related

environmental compliance (on La BARRANCA); Sacramento River Conservation Area support; assessment of public ownership impacts; and law enforcement support.

AFRP projects funded to date have directly or indirectly addressed limiting factors involving the effects of hatchery stocks on natural stocks to the largest extent. Given the size of the watershed and the magnitude of work to be done to address other limiting factors, AFRP projects have contributed to a much lesser extent. However, AFRP staff has provided technical support and advice on projects not funded by AFRP but that, in some cases, completely addressed some limiting factors. For example, water quality problems associated with Iron Mountain Mine have been (essentially) completely addressed, as has migration problems associated with the Anderson Cottonwood Irrigation District Diversion Dam and the temperature requirements between Keswick Dam and Bend Bridge. Extensive work on riparian habitat acquisition and restoration has been implemented along the river, including substantial increases in federal and private ownership (e.g. the Nature Conservancy properties). It is anticipated that it will take several more years to more fully address all of the limiting factors in the watershed.

The watershed's contribution to addressing AFRP Program Objectives is as follows: AFRP projects have gathered information to contribute to the dataset needed to meet objectives 1 through 4 (e.g. information from genetics studies and other fisheries monitoring efforts, habitat restoration), and objective 6 is being addressed through active collaboration with the Sacramento River Conservation Area Forum, natural resource agencies, and other parties.

Using only funding from AFRP projects as a criteria (and allowing some level of indirect contribution from studies, as opposed to project implementation), it is estimated that 8% of the work needed to address upper mainstem Sacramento River limiting factors and implement watershed actions has been completed; however, if one were to include funding from other sources, roughly 50% of the potential solutions to limiting factors have been addressed.

Cow Creek

Although Cow Creek AFRP restoration efforts have addressed about 5% of the AFRP Restoration Plan actions and evaluations (Table 3^b), a considerable number of restoration projects remain to be implemented to attain the natural production doubling goal. It is also estimated that about 5% of the work needed to address Cow Creek limiting factors and implement watershed actions has been completed.

AFRP staff are integrated with local watershed efforts and are technical advisors to the watershed group. Two AFRP-funded projects have been implemented in recent years in this watershed, involving water quality studies and completing a watershed management plan. An additional project gathered information on juvenile use in the lower watershed, in addition to gathering this information on other tributaries of the upper Sacramento River.

Several data gaps need to be addressed to better deal with passage, flow, and entrainment limiting factors, including a map and information on all diversions and other land use impacts. –Information gathered by AFRP projects in Cow Creek can be used to begin addressing the four AFRP actions in Cow Creek. For example, the Cow Creek Watershed Management Plan (nearly completed) identifies the potential impact of diversions and recommends prioritizing diversion screening and ladder improvement. AFRP funding will be requested for passage improvement projects. Primary impacts on riparian habitat in the watershed are believed to be non-native plant invasion, development, and agricultural practices. Mapping the riparian habitat would be the most useful way to identify and prioritize riparian habitat restoration and conservation.

The watershed's contribution to addressing AFRP objectives is as follows: AFRP projects have gathered information to contribute to the dataset needed to meet objectives 1 through 4 (e.g. information from Cow Creek watershed assessment and plan; water quality data collection), and Objective 6 is being addressed through active collaboration with the local resource conservation district, watershed group, natural resource agencies, and other parties.

The Cow Creek Watershed Management Group received a 2005 demonstration project grant from CBDP which was used to study the use of holding ponds (to address water quality) and to repair a diversion to provide improved passage. Technical support to maintain open space (land acquisition and conservation easements) is also a priority for local state and federal agencies, as well as conservation groups. Cow Creek is also a third Tier priority CBDP Environmental Water Program stream, but no actions have been initiated to date with this program.

Battle Creek

Although Battle Creek AFRP restoration efforts have addressed about 25% of the AFRP Restoration Plan actions and evaluations (Table 3^b), a considerable number of restoration projects remain to be implemented to attain the natural production doubling goal. It is also estimated that about 20% of the work needed to address Battle Creek limiting factors and implement watershed actions has been completed.

AFRP staff serve as technical reviewers for many facets of the Battle Creek Restoration Program. HRC's serve in a fisheries role and the AFRP funded Endangered Species program staff at Sacramento Fish & Wildlife Office serve on the Environmental Team for completing the environmental documentation. See

www.usbr.gov/mp/nepa/nepa_projdetails.cfm?Project_ID=99 for the final EIS/EIR.

Other limiting factors identified by CBDP are in-process with various sources of funding (e.g. increasing the flow past hydropower diversions to quantities needed to provide near-optimum passage, spawning, and rearing of anadromous fish; ensuring upstream passage for adults at hydropower facilities; effectively screening Orwick Diversion and PG&E diversions to prevent entrainment of juvenile salmonids; and, prevent straying of adults by building a barrier at the Gover Diversion). Several data gaps need to be addressed to

better deal with passage, flow, and entrainment limiting factors. An ongoing project is the multi-agency/private diverter effort to make the Orwick Diversion fish-friendly by constructing a headgate structure to insure that the DFG fish screen operates properly. An upcoming project will provide the environmental documentation for screening the CNFH intakes. The watershed group's "strategy" document is being considered for revision/updates (originally funded by AFRP).

Bear, Antelope, and Paynes creeks

No AFRP-funded projects have been implemented in these watersheds; therefore, (using AFRP-funded projects as a criteria), 0% of the work needed to address Bear, Antelope and Paynes creeks' limiting factors and implement watershed actions has been completed (Table 3^b). If funding were included from CBDP, roughly 10% of the potential solutions to limiting factors have been addressed.

These three watersheds were combined due to their comparable size, proximity to each other and similar issues. AFRP staff are well integrated with local watershed efforts and are technical advisors to local groups, such as the Tehama County Resource Conservation District and the U.S. Forest Service (Lassen National Forest), which are the most active entity in Paynes and Antelope Creeks with respect to watershed planning and project implementation. The Bear Creek Watershed Group and the Western Shasta Resource Conservation District are the most active in Bear Creek. In addition to the Bear Creek watershed assessment, CBDP funds were used to pay for the Antelope/Deer/Mill Creeks Watershed Assessment (prepared by the Forest Service), as well as road inventories in the upper portions of Antelope Creek. Tehama County RCD, along with input on natural resource values from technical advisors, is also actively involved in the update of the Tehama County Management Plan, which is currently underway and could have an impact on the conditions of Paynes and Antelope creeks (Bear Creek lies in Shasta County). Antelope Creek is a Tier 3 priority stream for the CBDP Environmental Water Program, but no projects have been identified as part of this program.

Several data gaps need to be addressed to better deal with passage, flow, and entrainment limiting factors caused by agricultural diversions, including a map and information on all diversions. Limiting factors involving habitat conditions (spawning gravel, channel structure) have not been addressed to a large extent. Information gathered by the Bear Creek Watershed Assessment (currently ongoing, funded by CBDP Watershed Program) could be used to help address these data gaps and better prioritize how to address the two AFRP actions in Bear Creek, one of which is ranked "High" in the AFRP Working Paper. Antelope Creek was assessed as part of a U.S. Forest Service Watershed Assessment, but only the upper watershed was addressed. Data gaps on the flow regime, habitat conditions, land use, and historical conditions are best served by preparing a Paynes/Antelope watershed assessment, which would consolidate all known natural resource and cultural information on the watersheds. Fish population information is limited and sporadic: Fisheries surveys for spring-run Chinook occur on Antelope Creek, and there is a volunteer effort to conduct (fall-run Chinook) carcass counts on Bear Creek, but there are no regular surveys conducted on Paynes Creek.

Timelines to address limiting factors is contingent on funding and willingness of local entities to participate in restoration. The Bear Creek Watershed Assessment will be completed by late 2005; what will follow are projects and a watershed management plan. Other efforts (such as a watershed assessment and plan for Paynes and Antelope creeks) are dependent on funding availability. Negotiations to ensure better water availability instream has not commenced on any of these streams.

The watersheds' contribution to addressing AFRP Objectives is as follows (although the contribution did not come through funding by AFRP): Information is being gathered on Bear Creek to contribute to the dataset needed to meet Objectives 1 through 4 (e.g. information from draft Bear Creek watershed assessment), and Objective 6 is being addressed on all three watersheds through active collaboration with the local resource conservation district, watershed groups, natural resource agencies, and other parties.

Cottonwood Creek

No AFRP-funded projects have implemented in this watershed; therefore, (using AFRP-funded projects as a criteria), 0% of the work needed to address Cottonwood Creek's limiting factors and implement watershed actions has been completed (Table 3^b); however, if one were to include funding from other sources, roughly 10% of the potential solutions to limiting factors have been addressed.

AFRP staff are well integrated with local watershed efforts and are technical advisors to the Cottonwood Creek Watershed Group, which is the most active entity in the watershed. In addition to the Cottonwood Creek watershed assessment, CDBP funded a watershed management strategy (currently underway), a watershed management plan, a geomorphological analysis of portions of the lower watershed, and an environmental education grant. Tehama County RCD, along with input on natural resource values from technical advisors, is also actively involved in the update of the Tehama County Management Plan, which is currently underway and could have an impact on the conditions of the south side of Cottonwood Creek.

Several data gaps need to be addressed to better assess straying/stranding, water quality, erosion, and habitat conditions caused by land management practices (e.g. gravel mining, agriculture, development). Limiting factors involving habitat conditions (spawning gravel, channel structure) have not been addressed to a large extent. For example, there is a growing concern about bank stability in the lower watershed; many acres of established riparian forest and managed pasture have been washed away in the last 20 years as the creek is attempting to stabilize itself from natural and human-caused events. Land development is also a growing issue. Information gathered by the Cottonwood Creek Watershed Assessment (2001) has better defined where data gaps lie; in addition, a watershed management strategy is currently being developed, which can better prioritize how to address the six AFPR actions in Cottonwood Creek, three of which are ranked "High" in the AFRP Working Paper.

Fish population information is limited and sporadic: Fisheries surveys for spring-run Chinook occur on a tributary (Beegum Creek), and there are limited inventories in the lower watershed (fall-run Chinook). Concerns regarding riparian habitat conditions are best addressed by a comprehensive map of watershed riparian habitat, which currently does not exist. Primary impacts on riparian habitat in the watershed are believed to be stream morphology changes, non-native plant invasion, development, and certain agricultural practices. Mapping the riparian habitat would be the most useful way to identify and prioritize riparian habitat restoration and conservation. Timelines to address Limiting Factors is contingent on funding and willingness of local entities to participate in restoration. The Watershed Management Strategy will be completed by late 2005; what will follow are projects and a watershed management plan. Other efforts (such as actively addressing gravel mining impacts) must involve Tehama County local government participation.

The watersheds' contribution to addressing AFRP Objectives is as follows (although the contribution did not come through funding by AFRP): Information is being gathered on Cottonwood Creek to contribute to the dataset needed to meet Objectives 1 through 4 (e.g. information from watershed assessment and strategy), and Objective 6 is being addressed through active collaboration with the watershed group, natural resource agencies, and other parties.

Thomes and Elder creeks

Thomes and Elder creeks were combined due to their immediate proximity to each other and similar issues.

No AFRP-funded projects have implemented in these watersheds; therefore, (using AFRP-funded projects as a criteria), 0% of the work needed to address Thomes and Elder Creeks' limiting factors and implement watershed actions has been completed (Table 3^b); however, if one were to include funding from other sources, roughly 15% of the potential solutions to limiting factors have been addressed.

AFRP staff are well integrated with local watershed efforts and are technical advisors to local groups, such as the Tehama County Resource Conservation District, which is the most active entity in these watersheds with respect to watershed planning and project implementation. In addition to the watershed assessment, CBDP funds have been used to identify and control noxious weeds in the area (demonstration project), as well as educate landowners on Best Management Practices for various land management activities. Tehama County RCD, along with input on natural resource values from technical advisors, is also actively involved in the update of the Tehama County Management Plan, which is currently underway. Timber harvest impacts are currently being addressed through newer regulations on timber harvest implemented by the state (Timber Harvest Plan review) and the federal government (U.S. Forest Service, Northwest Forest Plan), which has improved protection to riparian and aquatic habitats since the mid-1990's.

Several data gaps need to be addressed to better deal with passage, flow, and entrainment limiting factors, including a map and information on all diversions and other land use impacts such as gravel mining, grazing, and upper watershed activities (e.g. timber harvest). Erosional impacts and water quality are also two areas where there is a general lack of information in the watersheds (monitoring these parameters are two High Priority Evaluation Tasks for Thomes Creek). Information gathered by the West Tehama Watershed Assessment (currently ongoing, funded by CBDP Watershed Program) could be used to help address these data gaps and better prioritize how to address the five AFRP actions in Thomes and Elder Creeks, four of which are ranked “High” in the AFRP Working Paper. Concerns regarding riparian habitat conditions are best addressed by a comprehensive map of watershed riparian habitat, which currently does not exist. Primary impacts on riparian habitat in the watershed are believed to be non-native plant invasion, development, and agricultural practices. Mapping the riparian habitat would be the most useful way to identify and prioritize riparian habitat restoration and conservation. Timelines to address Limiting Factors is contingent on funding and willingness of local entities to participate in restoration. The Watershed Assessment will be completed by 2007; what will follow are projects and a watershed management plan. Other efforts (such as actively addressing gravel mining impacts) are dependent on the actions of the county and CALTRANS.

The watersheds’ contribution to addressing AFRP Objectives is as follows (although the contribution did not come through funding by AFRP): Information is being gathered to contribute to the dataset needed to meet Objectives 1 through 4 (e.g. information from draft West Tehama watershed assessment), and Objective 6 is being addressed through active collaboration with the local resource conservation district, natural resource agencies, and other parties.

Mill Creek

Although Mill Creek AFRP restoration efforts have addressed about 60% of the AFRP Restoration Plan actions and evaluations, a considerable number of restoration projects remain to be implemented to attain the natural production doubling goal. It is also estimated that about 60% of the work needed to address Mill Cow Creek limiting factors and implement watershed actions has been completed (Table 3^b).

AFRP staff are well integrated with local watershed efforts and are technical advisors to the Mill Creek Conservancy, which is the most active entity in these watersheds with respect to watershed planning and project implementation. In addition to the BOR grant, various CBDP grants have been obtained to complete an upper watershed assessment (U.S. Forest Service), road erosion inventory and road improvements, and restoration project. Mill Creek is identified as a Tier One Priority Stream for the CBDP Environmental Water Program (EWP), but no projects have been identified at this time.

Twelve AFRP-funded projects have been implemented in the watershed, involving water quality and flow monitoring studies, riparian restoration and easement acquisition, and fluvial geomorphology studies (an additional study to investigate hydroacoustic

techniques for fisheries inventories was funded in FY05 but has not begun). In addition to AFRP projects on Mill Creek which addressed two of the five limiting factors, most of the limiting factors involving fish passage, instream habitat conditions (in the valley floor), and diversion impacts is currently being addressed to some degree by a water efficiency/fish passage grant which the Mill Creek Conservancy received in 2003 from the U.S. Bureau of Reclamation (BOR). The grant is currently being implemented (expected completion by FY07); information from the grant will help to identify irrigation efficiency projects, minimum flows required for fish passage, and passage issues/project (such as aggraded channel sites). One of the anticipated results of this project is to better identify flows at which passage is difficult and where instream habitat restoration is needed. Other limiting factors involving riparian habitat are best served by comprehensive riparian mapping, which can then lead to prioritization of future restoration and conservation projects. Finally, while a watershed management plan has already been completed, it is now 5 years old and needs to be revisited and updated.

The watershed's contribution to addressing AFRP objectives is as follows: AFRP projects have gathered information to contribute to the dataset needed to meet Objectives 1 through 4 (e.g. information from Mill Creek Watershed Management Strategy Report; water quality data collection), and Objective 6 is being addressed through active collaboration with the Conservancy, natural resource agencies, and other parties. Mill Creek implementation projects have also addressed AFRP Objective 1 by improving habitat conditions (i.e. riparian habitat).

Deer Creek

Although Deer Creek AFRP restoration efforts have addressed about 60% of the AFRP Restoration Plan actions and evaluations, a considerable number of restoration projects remain to be implemented to attain the natural production doubling goal. It is also estimated that about 25% of the work needed to address Deer Creek limiting factors and implement watershed actions has been completed (Table 3^b).

AFRP staff are well integrated with local watershed efforts and are technical advisors to the Deer Creek Watershed Conservancy, which is the most active entity in this watershed with respect to watershed planning and project implementation. In addition to the BOR grant, various CBDP grants have been obtained to complete an upper watershed assessment (completed by the U.S. Forest Service), road erosion inventory and road-related restoration projects, meadow restoration, conservation easements, noxious weed removal (*Arrundo donax*), and environmental education. Four Pumps funding has been used as part of the water exchange agreement development—funds were used to purchase, install and monitor a groundwater well; the second phase of this project (two additional groundwater wells and associated monitoring). Deer Creek Irrigation District also received a water use efficiency grant in 2005 to assess the irrigation system and install improvements (to be initiated in 2006). Contributions to water savings via the efficiency grant will also contribute to the water made available for fish passage in the water exchange agreement. Deer Creek is also a Tier One watershed for the CBDP

Environmental Watershed Program (EWP); EWP staff are currently involved with negotiations on the water exchange program.

Seven AFRP-funded projects have been implemented in the watershed, involving water quality and flow monitoring studies, riparian restoration and easement acquisition, management strategy development, and upper watershed erosion project design (two additional fish passage projects at diversion dams were funded in FY04 and FY05 but are not yet implemented).

AFRP projects funded to date have directly or indirectly addressed limiting factors involving transportation flows, land use impacts, riparian vegetation, and flood management. AFRP HRC's serve as technical advisors on this project. Several ongoing efforts not funded by AFRP are actually addressing limiting factors to a large extent. The Deer Creek Watershed Conservancy has three grants to: conduct a floodplain feasibility study (to determine how to best manage large flood events from a cultural and ecosystem perspective); a California Department of Conservation grant—one of the tasks is to update the watershed management strategy; and a water monitoring and education grant, which is to be applied watershed-wide. The California Department of Water Resources and California Department of Fish and Game are working on a water exchange agreement with the Deer Creek Irrigation Company to better ensure fish passage flows. Two AFRP projects to improve fish passage at two diversion sites will be implemented within the next year. Future projects will be to hopefully engage the other irrigation company to become involved in fish improvement projects. Other limiting factors involving riparian habitat are best served by comprehensive riparian mapping, which can then lead to prioritization of future restoration and conservation projects. Some of this information will be obtained as part of the floodplain feasibility study in the lower watershed.

The watershed's contribution to addressing AFRP objectives is as follows:

AFRP projects have gathered information to contribute to the dataset needed to meet Objectives 1 through 4 (e.g. information from Deer Creek Watershed Management Strategy; water quality data collection), and Objective 6 is being addressed through active collaboration with the Conservancy, natural resource agencies, and other parties. Deer Creek implementation projects have also addressed AFRP Objective 1 by improving habitat conditions (i.e. riparian habitat, fish passage).

Big Chico Creek

Although Big Chico Creek AFRP restoration efforts have addressed about 60% of the AFRP Restoration Plan actions and evaluations, a considerable number of restoration projects remain to be implemented to attain the natural production doubling goal. It is also estimated that about 40% of the work needed to address Big Chico Creek limiting factors and implement watershed actions has been completed (Table 3^b).

AFRP staff serve as technical advisors to the citizen group in the Big Chico Creek watershed. Monthly watershed group meetings are held and citizen water quality monitoring is underway. Local television and newspapers have captured the positive

efforts by stakeholders in the watershed. Erosion control efforts are underway on some of the rural roads. A newsletter and website <http://www.bigchicocreek.org/> keep people information. The recently completed Existing Conditions report is available at the website. An upcoming effort between the citizens group, the university and fisheries agencies is a fish ladder at Iron Canyon Dam (initial designs were completed, now final decisions to proceed with construction are underway based on geological risk evaluation of the construction site in Iron Canyon which will soon be completed. AFRP funding is targeted for implementation of this fish ladder.

Butte Creek

Although Butte Creek AFRP restoration efforts have addressed about 80% of the AFRP Restoration Plan actions and evaluations, a smaller number of restoration projects remain to be implemented to attain the natural production doubling goal. It is also estimated that about 80% of the work needed to address Butte Creek limiting factors and implement watershed actions has been completed (Table 3^b).

With respect to the three Lower Butte Creek Project phases, Phase I (Existing Conditions) is 100% completed, Phase II (Engineering Design/Environmental Docs/Permits) is 80% completed, and, Phase III (Construction) is 60% complete for all approved projects.

The Lower Butte Creek Project is in the process of meeting three of the AFRP objectives. The applicable objectives are: 1) Improve habitat for all life stages of anadromous fish through provision of flows of suitable quality, quantity and timing and improved physical habitat. (the Giusti water right purchase agreement is nearing completion of the purchase of 21 cfs of in-stream flows); 2) Improve survival rates by reducing or elimination entrainment of juveniles at diversions (the Lower Butte Creek Project has constructed fish screens in the Sutter Bypass and adult fish barriers in the Butte Sink); and, 3) Improve the opportunity for adult fish to reach their spawning habitats in a timely manner (fish ladders have been constructed in the Sutter Bypass and the Butte Sink and is in the process of constructing a fish ladder at the White Mallard Dam site).

Miscellaneous small tributaries

Although miscellaneous small tributaries AFRP restoration efforts have addressed less than 1% of the AFRP Restoration Plan actions and evaluations (Table 3^b), a considerable number of restoration projects remain to be implemented to attain the natural production doubling goal. It is also estimated that about 5% of the work needed to address miscellaneous small tributaries limiting factors and implement watershed actions has been completed (Table 3^b).

AFRP staff are integrated with local watershed efforts and are technical advisors to local groups, such as the Tehama County Resource Conservation District and the Western Shasta Resource Conservation District, which are two of the most active entities in these watersheds with respect to watershed planning and project implementation. In addition to the watershed assessment, CBDP and private foundation (e.g. McConnell Foundation)

funds have been used to identify noxious weeds in the area. The Urban Streams Program of the California Department of Water Resources has provided funds to restore streams in the Redding Area, and Cantara Trustee funds have been used to improve fish passage on at least one small tributary. Tehama County RCD, along with input on natural resource values from technical advisors, is also actively involved in the update of the Tehama County Management Plan, which is currently underway.

Several data gaps need to be addressed to deal with habitat impacts (particularly salmonid rearing), water quality, passage, and flow limiting factors. Maps and information on all diversions, siphons/canal crossings and other land use impacts such as development and vegetation removal are also needed. A subset of these streams have many urban-related impacts (development near the stream, discharge impacts, flood management, etc.). Information gathered by the Shasta West Watershed Assessment (completed, funded by CBWP Watershed Program) identified erosional impact and water quality data gaps and the need to develop restoration projects. Concerns regarding riparian habitat conditions are best addressed by comprehensive maps of watershed riparian habitat, which currently do not exist for most small tributaries. Timelines to address Limiting Factors is contingent on funding and willingness of local entities to participate in restoration. The Tehama West Watershed Assessment (completion by 2006) and the Churn/Stillwater/Clover Creek Watershed Assessment (completion by 2006) will consolidate additional information on many of the small tributaries in Shasta and Tehama Counties that drain into the Sacramento River. Other efforts (such as actively addressing nonpoint discharges and development) are dependent on the actions of the two counties and some of the city governments (e.g. Redding, Red Bluff, and Anderson).

The watersheds' contribution to addressing AFRP Program Objectives is as follows (although the contribution did not come through funding by AFRP): information is being gathered to contribute to the dataset needed to meet objectives 1 through 4 (e.g. information from draft West Tehama, Shasta West and Churn/Stillwater/Clover Creeks watershed assessments), and objective 6 is being addressed through active collaboration with the local resource conservation district, natural resource agencies, and other parties.

Lower Sacramento River and Delta tributaries

The Lower Sacramento River and Delta tributaries region, which includes the Feather, Yuba, Bear, and American Rivers in the Lower Sacramento, and the Cosumnes, Mokelumne, and Calaveras rivers in the Delta tributaries region, is managed by federal and state AFRP HRC's. There are currently three AFRP HRC's, two federal and one state agency representative, and one assistant HRC charged with implementing restoration actions and evaluations that improve the anadromous fisheries in this region as described in CVPIA, 3406 (b)(1).

The AFRP HRC's assigned to the Lower Sacramento River and Delta tributaries region serve as technical advisors on watershed related work groups such as the FERC Oroville Relicensing Technical Working Groups, Feather River Technical Team, Yuba/Feather Work Group, Upper Yuba Studies Program Agency and River Teams, Lower Yuba River

Technical Working Group, Lower Yuba River Management Team, South Yuba Screen Work Group, Yuba River Modeling Forum, American River Operations Group, American River Fish Working Group, American River Gravel Study Advisory Team, Lower American River Science Conference Planning Committee, Dry Creek Conservancy, Bear River Watershed Group, and the Cosumnes Water Acquisition Team.

The AFRP has invested more than \$2.3 million dollars towards sixteen projects in the lower Sacramento River tributaries region throughout the program's ten year history. Historically, the AFRP has invested over \$658,000 to a total of ten projects in the lower Sacramento River tributaries region. This includes eight projects totaling \$626,000 on the Yuba River and two projects totaling \$32,000 on the American River. Ongoing investments in the lower Sacramento River tributaries region total \$ 1.6 million, with five projects totaling \$1.1 million on the Yuba, and one project totaling \$466,082 on the American River.

Feather River

Although Feather River AFRP restoration efforts have addressed about 15% of the AFRP Restoration Plan actions and evaluations, a considerable number of restoration projects remain to be implemented to attain the natural production doubling goal. It is also estimated that about 30% of the work needed to address Feather River limiting factors and implement watershed actions has been completed (Table 3^b).

AFRP watershed objectives on the Feather River include: supplementing flows; improving flows for American shad, evaluating the effects of hatchery salmon on natural spawning and production of spring-run Chinook salmon; improving flows for white and green sturgeon, develop and utilize a temperature model, replenishing and cleaning spawning gravel; reducing flow fluctuations; maintaining suitable temperatures; rehabilitating and enhancing the riparian corridor; evaluating pulse flows for anadromous fishery benefit; evaluating predation on juvenile salmonids; and evaluating the effects of poaching and fishing on green and white sturgeon. Progress has been made on evaluating the benefits of increased flow, evaluating Oroville Dam operations in order to improve temperature conditions, evaluating the effects of pulse flows on the outmigration of juvenile salmonids and returning adults, and evaluating flow patterns for the benefit of green sturgeon and American shad. Based on current levels of funding, it is anticipated that it will take beyond 10 years to complete all of the AFRP actions and evaluations for the Feather River.

Progress on the above objectives has been achieved through the Federal Energy Regulatory Commission (FERC) Oroville Dam Hydro-power Relicensing Process led by the California Department of Water Resources (DWR); however all of these activities are simply evaluations and none are ready to be implemented. AFRP staff work with stakeholders in the watershed to track the completion of these evaluations and utilize the data to create implementation plans and strategies.

Some progress has been made on AFRP Program Objective 1, improving habitat for all life stages of anadromous fish through provision of flows of suitable quality, quantity, and timing, and improved physical habitat by implementing gravel augmentation and riparian enhancement (about 10% complete). The Feather River does not have significant issues with large unscreened diversions below Oroville Dam, so progress on objective 2, improving survival rates by reducing or eliminating entrainment of juveniles at diversions, is not of major concern; however, there are many issues that need to be addressed relative to objective 3, such as mined areas adjacent to the river channel that are captured during high water events that need to be addressed. Relative to objective 4, fish population, health, and habitat data are being collected to facilitate evaluation of restoration actions through the FERC Relicensing Process. The FERC collaborative process is making significant progress towards objective 5, integrating habitat restoration efforts with harvest and hatchery management (ongoing). The AFRP regularly involves partners in the implementation and evaluation of restoration actions (objective 6). To meet doubling goals, additional projects to improve instream, riparian, flood plain and side channel habitat need to be implemented.

The limiting factors for anadromous fish on the Feather River include: spawning habitat; rearing habitat; predation of juveniles below the Thermalito afterbay, adult passage above Oroville Dam; water temperature issues downstream of the Thermalito afterbay, and adverse impacts of hatchery origin salmon on spring-run Chinook salmon genetic integrity. AFRP is working closely with DWR, Bureau of Reclamation, DFG and others to coordinate and plan restoration actions to address salmonid limiting factors.

Bear River

On the Bear River, tributary to the Feather River, none of the limiting factors or AFRP program objectives identified in the AFRP Final Restoration Plan have been implemented or initiated. This lack of accomplishment on the Bear River stems from the paucity of fish and habitat data gathered, and the perceived lack of habitat below Camp Farwest Reservoir. The CBDP Bay-Delta Program, Watershed Program funded the development of a watershed restoration plan, but this effort is primarily focused on the upper Bear River above Camp Farwest Reservoir. A baseline conditions RFP (request for proposals) was developed in 2005 for the lower Bear River and is ready to be submitted for FY2006 funding. In addition, an RFP was developed in coordination with Beale Air Force Base personnel and other stakeholders for making improvements to the existing fish ladder on Dry Creek, a tributary to the Bear River. This RFP will be ready for FY2006.

Yuba River

Although Yuba River AFRP restoration efforts have addressed about 40% of the AFRP Restoration Plan actions and evaluations, considerable restoration projects remain to be implemented until natural production doubling target has been accomplished. It is also estimated that about 40% of the work needed to address Yuba River limiting factors and implement watershed actions has been completed (Table 3^b).

The Yuba River supports spring-run, fall-run and late fall-run races of Chinook salmon, as well as American shad and Central Valley steelhead. AFRP watershed objectives on the Yuba River include: improving flows for salmonids and American shad; evaluating the effects of non-natal hatchery salmon on natural spawning and production of spring- and fall-run Chinook salmon; developing and utilizing a temperature model to maintain suitable temperatures; replenishing and cleaning spawning gravel; reducing flow fluctuations; constructing and improving the efficiency of fish screens; rehabilitating and enhancing the riparian corridor; reducing passage impediments including stranding, entrainment, and predation; evaluating pulse flows for anadromous fishery benefit; and evaluating predation on juvenile salmonids. Progress has been made on evaluating the benefits of increased flow, developing a temperature model, evaluating the effects of pulse flows on the outmigration of juvenile salmonids and returning adults, and improving the efficiency of screening devices. Based on current levels of funding, it is anticipated that it will take well beyond 2015 to complete all of the AFRP actions and evaluations for the Yuba River.

On the Yuba River, several AFRP actions and evaluations are currently being addressed through the Revised Water Rights Decision 1644 and Yuba Accord process. These include improving flow conditions for all life history stages of Chinook salmon and steelhead; reducing and controlling flow fluctuations; maintaining adequate in-stream flows for temperature control; operating reservoirs to provide adequate water temperatures for anadromous fish; evaluating the benefits of restoring stream channel and riparian habitats of the Yuba River, including the creation of side channels for spawning and rearing habitats for salmonids. The estimated timeline for the Yuba Accord Process, which is a collaborative process resulting from the State Water Resources Control Board decision 1644, is a one-year pilot program in 2006, followed by implementation of the accord in 2007.

Limiting factors yet to be addressed on the Yuba River include: improving flows for shad life history; facilitating passage of spawning adult salmonids by maintaining appropriate flows through the fish ladders, or modifying the fish ladders at Daguerre Point Dam; juvenile entrainment losses at the South Yuba-Brophy diversion; purchasing conservation easements to restore salmonid habitat and instream cover (stream habitat restoration); assessing the effectiveness of pulse flows for juvenile salmonids emigration; evaluating New Bullards Bar and Englebright Dam operations for water temperature control; and maintaining water temperatures between 61 – 65°F for at least one month from April 1 to June 30 for American shad.

The AFRP works collaboratively with other federal and state agencies and stakeholders in the Lower Yuba River. The engineering and design phase of the Narrows II hydropower bypass project was funded by the AFRP (\$299,606), and the construction phase is being funded by the CBDP Bay-Delta Program. In addition the AFRP works with the Yuba County Water Agency, California Department of Fish and Game, and National Marine Fisheries Service to plan, collect, and analyze fish population, health and habitat data to facilitate the evaluation of restoration actions.

Cosumnes River

Although Cosumnes River AFRP restoration efforts have addressed about 30% of the AFRP Restoration Plan actions and evaluations, a considerable number of restoration projects remain to be implemented to attain the natural production doubling goal. It is estimated that about 50% of the work needed to address Cosumnes River limiting factors and implement watershed actions has been completed (Table 3^b).

AFRP watershed objectives on the Cosumnes River include: supplementing flows; purchasing water rights; prohibiting construction of unlicensed dams; screening all diversions; establishing a riparian protection zone; reducing sedimentation and instream water temperatures; reevaluating instream flow requirements; replenishing and increasing spawning habitat; and facilitating passage of adult and juvenile salmonids at existing diversion dams and barriers. Progress has been made on evaluating the benefits of increased flow; evaluating the effects of pulse flows on the outmigration of juvenile salmonids and returning adults; facilitating passage of salmonids at existing dams and barriers; and identification of opportunities to purchase water rights. Based on current levels of funding, it is anticipated that it will take beyond 2010 to complete all of the AFRP actions and evaluations for the Cosumnes River.

Minimal progress has been made on AFRP Program Objective 1, improving habitat for all life stages of anadromous fish through provision of flows of suitable quality, quantity, and timing, and improved physical habitat by implementing gravel augmentation and riparian enhancement (10% complete). The Cosumnes River does not have significant issues with large unscreened diversions, so progress on objective 2, improving survival rates by reducing or eliminating entrainment of juveniles at diversions, is not of major concern; however, the Cosumnes has issues that need to be addressed relative to objective 3. For instance, sections of the river go dry during the summer and early fall as a result of ground water pumping. Relative to objective 4, fish population, health, and habitat data have been and are being collected to facilitate evaluation of restoration actions. In reference to objective 5, integrating habitat restoration efforts with harvest and hatchery management, the Cosumnes likely has issues with Mokelumne River hatchery strays, but it is unclear how significant this issue is. The AFRP is working with other stakeholders in the basin to address this issue. The AFRP regularly involves partners in the implementation and evaluation of restoration actions (objective 6). To meet doubling goals, additional projects to improve instream, riparian, flood plain and side channel habitat need to be implemented.

The limiting factors for anadromous fish on the Cosumnes River include: insufficient flow, stream habitat restoration, spawning habitat; rearing habitat; predation of juveniles, fish passage, effects of hatchery fish on natural stocks, and erosion and sediment control. The AFRP is working closely with the Nature Conservancy, UC Davis, the Fishery Foundation, Bureau of Reclamation, DFG and others to coordinate and plan restoration actions to address these salmonid limiting factors.

Mokelumne River

Although Mokelumne River restoration efforts have addressed 30% (Table 3) of the AFRP Restoration Plan actions and evaluations, approximately 5% of the necessary effort to double natural production has been completed (Table 3^b).

AFRP watershed objectives on the Mokelumne River include: supplementing flows; replenishing and cleaning spawning gravel; reducing flow fluctuations; screening diversions; maintaining suitable temperatures; enhancing the riparian corridor; establishing water quality standards; eliminating flood plain gravel mining; evaluating pulse flows; facilitating passage through Woodbridge Dam, evaluating the effects of hatchery salmon production on natural spawning; and evaluating predation on juvenile salmonids; and evaluating fishing closures. Progress has been made on replenishing and cleaning spawning gravel, enhancing the riparian corridor, evaluating pulse flows, facilitating passage through Woodbridge Dam and evaluating predation on juvenile salmonids. Assuming current levels of funding, completion of the AFRP actions and evaluations will likely take beyond 10 years to complete.

Minimal progress has been made on AFRP Program Objective 1, improving habitat for all life stages of anadromous fish through provision of flows of suitable quality, quantity, and timing, and improved physical habitat by implementing gravel augmentation and riparian enhancement (5% complete). Little progress has been made on objective 2, improving survival rates by reducing or eliminating entrainment of juveniles at diversions. Reconstruction of Woodbridge Dam should benefit objective 3 and improve the opportunity for adult fish to reach their spawning habitats in a timely manner (dam retrofit 50% complete, flows ongoing). Relative to objective 4, fish population, health, and habitat data is being collected to facilitate evaluation of restoration actions both by AFRP and others (ongoing). Some progress is being made towards objective 5, integrating habitat restoration efforts with harvest and hatchery management (ongoing). AFRP restoration efforts contribute continuously to objective 6, regularly involving partners in the implementation and evaluation of restoration actions (ongoing). To meet doubling goals, additional projects to improve instream, riparian, flood plain and side channel habitat need to be implemented and many unscreened diversions need to be screened. The most significant limiting factors for salmonids on the Mokelumne River include: spawning habitat; rearing habitat; predation on juveniles below Woodbridge Dam; adult passage at Woodbridge Dam; invasive aquatic plant species; adverse impacts of hatchery origin salmon; and the use of Feather River steelhead broodstock.

AFRP is working with EBMUD to coordinate and plan restoration actions to address salmonid limiting factors. Woodbridge Dam reconstruction is a CBDFP funded project. AFRP, EBMUD, The California Department of Fish and Game (CDFG) and the National Marine Fisheries Service (NMFS) participate regularly as part of the Joint Settlement Agreement to facilitate management of the river.

Calaveras River

Although Calaveras River restoration efforts have addressed about 30% of the AFRP Restoration Plan actions and evaluations, approximately 1% of the necessary effort to double natural production has been completed (Table 3^b) with the majority of current efforts focused on building consensus and partnerships between the Stockton East Water District (SEWD), agencies and environmental groups.

AFRP watershed objectives on the Calaveras River include: supplementing flows; providing suitable temperatures; facilitating passage; screening diversions; monitoring sport-fishing and evaluating instream flow, water temperature and fish habitat use. To meet doubling goals, physical improvements to flashboard dams and Bellota Weir must be constructed then additional projects to improve instream, riparian, flood plain and side channel habitat need to be implemented. Unscreened diversions need to be screened. Water needs to be set aside for dedicated fisheries flows. Since little or no restoration has occurred to date and with current funding and activity levels, completion of AFRP actions and evaluations will likely take beyond 10 years to complete.

Minimal progress has been made on AFRP Program Objective 1, by coordinating flow releases from New Hogan Dam (2% complete). Little progress has been made on objective 2, though monitoring has documented the occurrence of stranding (<1%). Retrofitting the Bellota Weir fish ladder will benefit objective 3, improved the opportunity for adult fish to reach their spawning habitats in a timely manner though ladder problems still exist as well as flashboard dam issues (5%). Relative to objective 4, fish population, health, and habitat data is being collected to facilitate evaluation of restoration actions both by AFRP and others (ongoing). No progress has been made towards objective 5, integrating habitat restoration efforts with harvest and hatchery management (ongoing). AFRP restoration efforts contribute continuously to objective 6 by regularly involving partners in the implementation and evaluation of restoration actions through the Calaveras River Fish Group and the Habitat Conservation Plan workgroup (ongoing).

The most significant limiting factors include passage and entrainment or stranding resulting from instream diversions and insufficient flow. The projects listed above have focused primarily on the limiting factors of passage and flow. Plans are underway to fund additional passage improvements (AFRP) and reduce entrainment by SEWD. Once these issues have been resolved restoration of habitat above Bellota can commence.

On the Calaveras River, AFRP is working with state and federal agencies, non-profit organizations and SEWD to solve steelhead and Chinook salmon passage and entrainment issues. CBDP has funded an engineering study to retrofit Bellota Weir and diversion. AFRP facilitates the Calaveras River Fish Group and participates in the Habitat Conservation Plan workgroup.

San Joaquin Basin tributaries and mainstem San Joaquin River

This AFRP geographic area includes the Stanislaus, Tuolumne and Merced rivers including the mainstem San Joaquin River. Each of the watersheds within this AFRP geographic region has unique characteristics and environmental limiting factors. There

are currently two AFRP HRC's, one federal assistant HRC, and one state HRC dedicated to the implementation of restoration actions in the San Joaquin Basin tributaries and the mainstem San Joaquin River. AFRP duties in this geographic region are expanding as new watershed and stakeholder groups become organized, restoration plans are developed and large-scale restoration projects and greater numbers of restoration activities are implemented. HRC's served as technical advisors on watershed related groups such as the Stanislaus Temperature Modeling Group, San Joaquin Basin Temperature Modeling Group, Stanislaus Fish Group, Tuolumne River Technical Advisory Committee, Merced River Technical Advisory Committee, Merced River Stakeholder Group, Western Stones Planning Group, Delta Pumping Plant Fish Protection Agreement Advisory Committee, the Dredge Tailings Workgroup, State Taskforce on Rivers and the Effects of Aggregate Mining (STREAM), the Vernalis Adaptive Management Program, and the San Joaquin River Management Program.

Stanislaus River

Although Stanislaus River restoration efforts have addressed about 30% of the AFRP Restoration Plan actions and evaluations, approximately 5% of the necessary effort to double natural production has been completed (Table 3^b). Most of the necessary restoration projects could be completed in 10-20 years with appropriate levels of funding.

AFRP watershed objectives on the Stanislaus River include: implementing an interim river regulation plan; improving watershed management to restore and protect instream and riparian habitat; screen diversions; providing suitable water temperatures and flows; reducing predation; ensure adequate water for the third year of a critical period and evaluate fall pulse flows. Fall-run Chinook salmon populations continue to decline with average 1992-2004 production of 7,846, a decline of over 3,000 (28%) from the baseline period (1967-1991) average production of 10,924. To meet doubling goals, additional projects to improve instream, riparian, flood plain and side channel habitat need to be implemented and many unscreened diversions need to be screened. Assuming current levels of funding, completion of the AFRP actions and evaluations could take beyond 10 years to complete. Replacing the 20,000 cubic yard annual gravel deficit at \$50 per cubic yard (includes monitoring) will cost roughly \$10,000,000 per year assuming that gravel costs do not escalate as gravel supplies are reduced.

Restoration efforts on the Stanislaus River have focused mainly on improving instream spawning habitat (limiting factors spawning habitat and stream habitat restoration). Projects have been conducted by the California Department of Water Resources (DWR) Four-Pumps, the California Department of Fish and Game (DFG) CBDP, the United States Bureau of Reclamation (USBR) b(13) program and AFRP. CBDP has funded the Stanislaus River Temperature Model and the Knight's Ferry Gravel Augmentation Project Phase I. The largest gravel augmentation occurred in 1999 adding approximately 8,000 cubic yards of spawning gravel.

Minimal progress has been made on AFRP Program Objective 1, by implementing gravel augmentation and riparian enhancement (5% complete). Little progress has been made

on objective 2, by reducing or eliminating entrainment of juveniles at diversions though this appears to be a minor limiting factor (1%), and improving the opportunity for adult fish to reach their spawning habitats in a timely manner (objective 3) has been partially achieved through the use of fall pulse flows, though dissolved oxygen, temperature and export problems continue to create problems (ongoing). Relative to objective 4, fish population, health, and habitat data is being collected to facilitate evaluation of restoration actions both by AFRP and others although funding monitoring is increasingly difficult (ongoing). Little progress is being made towards objective 5, integrating habitat restoration efforts with harvest and hatchery management (ongoing). AFRP restoration efforts contribute continuously to objective 6 by regularly involving partners in the implementation and evaluation of restoration actions through the Stanislaus River Fish Group (ongoing).

The most significant limiting factors on the Stanislaus River include; spawning and rearing habitat; insufficient flows and predation. According to a recent study (Kondolf et al. 2001)¹, approximately 20,000 cubic yards of gravel are lost annually due to dams blocking recruitment. Approximately 1 million cubic yards were removed from the river channel through mining, with an additional 5.2 million cubic yards mined from the floodplain. Two of the previously listed projects address the limiting factors of spawning habitat and stream habitat restoration. Gravel augmentation along with appropriate flows, appears to be the most effective short-term forms of restoration.

Another project, Spawning Habitat Restoration in the Stanislaus River, Lover's Leap reach will be augmenting spawning gravels and restoring floodplain and side-channel habitats. Construction should begin during summer 2006.

AFRP facilitates the Stanislaus River Fish Group, a technical group devoted to restoring anadromous fish within the river. AFRP participates in the Stanislaus River Temperature Model study and stakeholder flow discussions.

Tuolumne River

Although Tuolumne River restoration efforts have addressed about 40% of the AFRP Restoration Plan actions and evaluations, approximately 15% of the necessary effort to double natural production has been completed (Table 3^b).

AFRP watershed objectives include: (1) implementing the FERC agreement flows and acquiring additional water from willing sellers; (2) improving watershed management to restore and protect instream and riparian habitat; (3) screen diversions; and (4) evaluate the influence of water temperature on all life stages of anadromous fish, predation on juvenile fish, and fall pulse flows on adult attraction. In spite of the combined AFRP, CBDA, and Delta Pumping Plant Fish Protection Agreement (a.k.a. 4-Pumps) restoration efforts, fall-run Chinook salmon populations have declined by about 46% from a baseline period (1967-1991) average production of about 19,000 to an average 1992-2004 production of about 10,000. To meet doubling goals, additional projects to improve and

evaluate instream flows, instream habitats, and floodplain habitats need to be implemented. Completion of the new high priority AFRP actions and evaluations could take an estimated \$65,000,000 and at least another 10 years to complete.

The AFRP and stakeholders have identified four significant limiting factors on the Tuolumne River: (1) insufficient flows, (2) degraded spawning, rearing, and floodplain habitats, (3) predation, and (4) excessive sedimentation (Tuolumne River Habitat Restoration Plan). Perhaps the most severe limiting factor for the Tuolumne River is insufficient flows. The current minimum flow schedule, as prescribed by the 1995 FERC Settlement Agreement, provides no more than 13 percent of the unimpaired flows to sustain the fall-run Chinook salmon population. Moreover, the FERC Settlement Agreement does not require adequate summer flows needed to sustain juvenile Central Valley steelhead. To help improve flow releases in the Tuolumne River, the AFRP provides technical evaluations of the impacts of flow diversions on the anadromous fish populations to the State Water Resources Control Board, the Federal Energy Regulatory Commission, and the Tuolumne River Technical Advisory Committee. The AFRP also supports completing the Infiltration Gallery near River Mile 26 for approximately \$10,000,000; this project would allow the irrigation districts to increase instream flows by 100 cfs in the upper spawning and rearing reaches and then recapture the water at the Infiltration Gallery. The AFRP is funding an ongoing study of the effectiveness of fall pulse flows intended to attract upmigrating adult salmon to the Tuolumne River, a CDFG spring 2005 smolt survival study, and assisting the development of a CBDA water temperature model.

Spawning, rearing, and floodplain habitats in the Tuolumne River have been extensively degraded by the dams blocking sediment recruitment from the upper watershed, gold dredging operations that occurred until 1952, and ongoing gravel extraction that began in the 1930s. Pit excavation and drag-line operations excavated many of the spawning beds and rearing habitats and isolated floodplain habitats from the river. Much of the spawning habitat in the unmined sections has become armored due to the lack of gravel recruitment. Gravel extraction has also created 10 large in-river pits, called Special Run Pools, and long ditches that have abnormally high abundances of potential predators that include largemouth bass, smallmouth bass, Sacramento pikeminnow, and striped bass. During the process of dredging, gravel extraction, and conversion to agriculture, much of the floodplain has been degraded or isolated from the river by dikes or buried under dredger tailings. McBain and Trush estimates that the total volume of sediment needed to restore the degraded habitats is approximately 2.6 million cubic yards of gravel plus an additional 1,000 to 2,500 cubic yards each year for maintenance. To begin restoring these degraded habitats, the AFRP, CBDA, and the Delta Pumping Plant Fish Protection Agreement (a.k.a. 4-Pumps) have collectively funded 11 spawning, rearing, and floodplain restoration projects for a total of \$45,694,843. The AFRP has contributed \$7,870,729 toward these projects.

Another high priority watershed objective for the Tuolumne River is the need to adequately assess habitat restoration efforts. Chinook salmon production to the Tuolumne River declined by about 46% (ChinookProd) between 1992 and 2004, the worst decline in the San Joaquin Basin. Although there are many elements of the

fisheries research program, we do not know why the population did not respond favorably to the implemented restoration projects or the revised minimum instream flow schedule implemented in 1996. To help address this decline (1) the AFRP has recommended a new flow regime and an adaptive management study program to amend the Federal Energy Regulatory Commission license for the New Don Pedro Project; (2) the CBDA is funding a water temperature model; (3) the AFRP is funding new studies to assess salmon egg survival in different sizes of restoration gravel, and (4) the CBDA has selected a multi-million dollar monitoring project for funding in 2006. However, additional stream channel, riparian, floodplain and gravel restoration, as well as studies are needed to restore the watershed and to assess the effectiveness of restoration to reduce predation of juvenile salmonids, conduct annual surveys of adult Central Valley steelhead abundance, and assess the effects of flow on juvenile health.

Merced River

Although Merced River restoration efforts have addressed about 60% of the AFRP Restoration Plan actions and evaluations, approximately 15% of the necessary effort to double natural production has been completed (Table 3^b).

AFRP watershed objectives include: (1) supplementing the existing minimum flow schedule by acquiring water from willing sellers; (2) improving watershed management to restore and protect instream and riparian habitat; (3) screen diversions; and (4) evaluate the influence of water temperature on all life stages of anadromous fish, predation on juvenile fish, and fall pulse flows on adult attraction. The fall-run Chinook salmon population has increased by about 4% from a baseline period (1967-1991) average production of about 9,000 to an average 1992-2004 production of about 9,400.

To meet doubling goals, additional projects to improve and evaluate instream flows, instream habitats, and floodplain habitats need to be implemented. Completion of the new high priority AFRP actions and evaluations could take an estimated \$100,000,000 and at least another 10 years to complete.

The most significant limiting factors on the Merced River include: (1) degraded spawning, rearing, and floodplain habitats, (2) predation (3) inadequate streamflow; (4) elevated water temperatures of release flows at Crocker-Huffman Dam when fall-run Chinook are spawning; (5) juvenile entrainment; (6) erosion and sedimentation; and (7) invasive species. Twenty miles of spawning, rearing, and floodplain habitats have been extensively degraded by a lack of sediment recruitment, gold dredging operations that occurred until about 1950, and ongoing gravel extraction that began in the 1930s. Gravel extraction has also created four large in-river pits that provide habitat for numerous black bass. During the process of dredging and gravel extraction, approximately nine miles of floodplain habitat were buried under dredger tailings or isolated from the river with dikes. Stillwater estimates that the total volume of sediment needed to restore the degraded habitats is approximately 1.6 million cubic yards of gravel plus an additional 2,600 cubic yards each year for maintenance. To begin restoring these degraded habitats, the AFRP,

CBDA, and 4-Pumps have collectively funded seven projects for a total of \$18,749,285. The AFRP has contributed \$375,000 toward these projects.

Insufficient flows and elevated water temperatures are significant limiting factors for the Merced River. The current minimum flow schedule, as prescribed by a memorandum of understanding between CDFG and the Merced Irrigation District, provides between 15 and 23 percent of the unimpaired flows to sustain the fall-run Chinook salmon population (AFRP flow recommendation workshop, July 28, 2005). Currently, flows for riparian water rights are also providing the summer flows needed to sustain juvenile Central Valley steelhead. A particular concern is that the temperature of flow releases at Crocker-Huffman Dam are too high (about 58 degrees Fahrenheit) in early November when salmon begin to spawn in the river and egg mortality is high at the Merced River hatchery. To help improve flow and water temperatures, the AFRP provides technical evaluations of the impacts of flow diversions on the anadromous fish populations to the State Water Resources Control Board and the Merced River Technical Advisory Committee. The AFRP is assisting the development of a CBDA water temperature model and have funded the collection of water temperature data (completed).

There are seven large wing-dam diversions on the Merced River that historically entrained a substantial number of juvenile salmonids. CDFG is being funded by 4-Pumps to screen all of these diversions. The Cowell diversion near Snelling was screened in spring 2005 and the others will be screened in the future. CDFG will monitor the effectiveness of these screens.

Consistently high turbidity of flow releases from Crocker-Huffman Dam may be a significant limiting factor, particularly for incubating eggs. No projects have been implemented to document the extent of the problem.

Non-native, invasive plant species, such as water hyacinth, tree of heaven, yellow starthistle, poison hemlock, London plane tree, Osage orange, sugar maple, mulberry, giant reed, and eucalyptus, commonly occur throughout the lower Merced River and are thought to be a limiting factor for anadromous fish. A pilot water hyacinth eradication project was funded by 4-Pumps.

Another high priority objective for the Merced River is the need to adequately assess habitat restoration efforts. The CBDP is funding a \$1.4 million, 3-year study to assess the effectiveness of the Robinson Ranch Project as well as a water temperature model. Additional studies are needed to evaluate the effectiveness of the 4-Pumps gravel augmentation projects near Snelling.